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# Mapping the Research Trends in Andhra University, Visakhapatnam: A Bibliometric analysis

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**Abstract**

This study delves into Andhra University's research output from 2009 to 2023, focusing on publication trends, citation impact, authorship patterns, and international collaborations. From a methodological perspective, the study uses bibliographic data from the Scopus database; a total of 7415 indexed publications were examined, aiming to dissect trends in publication growth, citations, authorship patterns, country affiliations, and participation. Bibliometric tools like VOS Viewer are used to visualize collaborative and thematic networks. Notable fluctuations in publication counts were observed over the years, with a noteworthy surge from 294 in 2009 to a peak of 664 in 2019, followed by a subsequent decline. Among prolific authors, Chowdary from the Department of Pharmaceutical Sciences stood out with 82 publications, while the Asian Journal of Chemistry emerged as a productive publication venue with 179 publications. Interestingly, many prolific authors did not feature prominently in highly cited publications. The United States emerged as a leading contributor after India, with 145 publications, followed by Ethiopia with 121 publications. Terms like 'Controlled Study' and 'Nonhuman' emerged as prevalent during the study period, reflecting current trends in research discourse.

**Keywords:** Andhra University, Bibliometric Study, Network Visualization, Publication Trends, Research Trends in Andhra University

## 1. Introduction

Andhra University, established in 1926, stands as a hallmark of academic excellence and research prowess in the Indian state of Andhra Pradesh(History of Andhra University, n.d.). Located in the coastal city of Visakhapatnam, it has become a leading centre for higher education and is known for promoting intellectual inquiry, innovation, and academic achievements across various fields. The university currently comprises 58 departments, 16 research centres, and 188 ICT-enabled classrooms, supplemented by advanced computer and GIS laboratories and 76 seminar halls, fostering a rich learning environment.

Research at AU is widely recognized, with numerous funded projects from organizations such as UGC, DST, DRDO, ISRO, and CSIR. The university's engineering and science programs are particularly well-regarded, and AU has established collaborations with various national and international research institutions to drive innovation.This dedication was recognized with an A++ grade and a CGPA of 3.74 out of 4 from the National Assessment and Accreditation Council (NAAC).

Understanding the research productivity of a prestigious institution like Andhra University provides valuable insights into its academic impact, global collaborations, and knowledge dissemination. This study is significant for multiple reasons:

- **Assessing Research Growth Trends:** By analyzing publications from 2009 to 2023, this study identifies patterns in research output, helping to track progress and emerging research areas.
- **Evaluating Citation Impact:** Citation analysis highlights the influence and reach of AU's scholarly contributions in various disciplines.
- **Authorship and Collaborative Networks:** Examining authorship patterns provides insight into faculty contributions, multi-authored publications, and interdisciplinary research trends.
- **Global Research Engagement:** Identifying country affiliations and collaborations helps assess AU's role in international research partnerships and its global academic presence.
- **Application of Bibliometric Tools:** Tools like VOS Viewer allow for a visual representation of thematic and collaborative networks, offering deeper analytical insights.

This study will help policymakers, academicians, and researchers in strategic decision-making, fostering institutional growth and enhancing research visibility.

This article explores the research output of Andhra University as recorded in the SCOPUS database from 2009 to 2023. SCOPUS provides a comprehensive repository of scholarly literature, essential for tracking and assessing research publications, citation metrics, and global collaboration networks.

## 2. Literature Review

A study by (Maddisetty & Babu, 2023)Examined the research output of Sri Venkateswara University in Andhra Pradesh, providing insights into publication trends and authorship patterns. Similarly, a scientometric study analyzed research publications from universities in Andhra Pradesh, focusing on author productivity and collaboration patterns . These studies highlight the application of bibliometric methods to evaluate institutional research performance. A bibliometric analysis conducted by(Rawat et al., n.d.) evaluated the research productivity of the Wadia Institute of Himalayan Geology (WIHG) from 1991 to 2020 using Scopus data and VOSviewer software. This study examined research growth, author productivity, collaboration metrics, and subject distributions, identifying the peak publication year 2017. The dominant subject area was Earth and Planetary Sciences, and P. Srivastava was the most prolific author.(Bapte, 2020)comprehensively analysed global research output on information literacy (IL) from 1975 to 2019, revealing 7070 records and 50584 citations. The "Communication in Computer and Information Science" journal led with 380 papers, while the "Journal of Academic Librarianship" had the highest citation rate. Pinto M from Universidad de Granada was the most prolific author.(R et al., 2020) studied the research productivity of Madras University, one of India's oldest institutions, using Web of Science data from 2009 to 2018. The study highlighted chemistry as the leading field of research and identified a

preference for UK journals among researchers.(Maharana & Das, n.d.) conducted a bibliometric analysis of Utkal University's research output from 2008 to 2012, recognising the International Journal of Earth Sciences and Engineering as the most favoured journal and P. K. Panda as the most prolific contributor.(Jeyshankar et al., 2011) analysed the bibliographic details of 1282 articles published by the Central Electrochemical Research Institute (CECRI) from 2000 to 2009, noting 2009 as the most productive year and highlighting significant collaborative research efforts.

The existing literature provides limited insights into the specific research performance of Andhra University. While studies have assessed research productivity in other institutions within Andhra Pradesh, a focused bibliometric analysis of Andhra University's scholarly output remains absent. This gap underscores the need for a detailed examination of the university's research contributions, trends, and impact.

## 3. Objectives

The objectives of the study are as follows:

- Evaluate the publication output of Andhra University as indexed in SCOPUS from 2009 to 2023.
- Analyse the types of research publications produced by Andhra University.
- Identify leading authors and notable journal publications affiliated with theuniversity.
- Pinpoint highly cited papers originating from Andhra University.
- Examine the countries collaborating with Andhra University in research efforts.
- Determine the distribution of keywords across the publications.

## 4. Methodology

The research focuses on examining Andhra University's Scopus-indexed publications from 2009 to 2023 using the search string: (AFFIL (Andhra AND University) AND AFFILCOUNTRY (India) AND AFFILCITY (Visakhapatnam)) AND PUBYEAR > 2009 AND PUBYEAR < 2024. Data was extracted and analysed using the R Platform Bibliometrix package and visualised with VOSviewer software. This study adopts a bibliometric approach, focusing primarily on the quantitative analysis of publications, citation patterns, and research productivity. While scientometrics encompasses a wider scope, including the study of the scientific process and research dynamics, our methodology is aligned with bibliometric techniques to assess publication trends and citation metrics within the selected dataset.Metrics such as total papers, highly cited papers, total citations, and H-Index were derived. Yearly growth rates were calculated using the formula:

$$AGR = \frac{End\ Value - First\ Value}{First\ Value} \times 100$$

Citations per paper were calculated by dividing total citations by the number of publications. The full counting method was used to determine country-wise productivity.

## 5. Data analysis and interpretation

This analysis of Andhra University's research publications indexed in SCOPUS from 2009 to 2023 reveals notable growth in both the quantity and quality of its scholarly output.

### 5.1 Year-wise research publication

The distribution of research output, annual growth rate, and citations received are given in Table 1 and Figure 1.

**Table 1: Research Publication Growth of AU**

| Year | Publications | % | Annual Growth Rate | Citations | Citation per Paper (CPP) |
|---|---|---|---|---|---|
| 2009 | 294 | 3.96 | 0 | 3752 | 12.76 |
| 2010 | 345 | 4.65 | 0.14 | 4018 | 11.64 |
| 2011 | 467 | 6.29 | 0.26 | 4137 | 8.85 |
| 2012 | 476 | 6.41 | 0.01 | 5840 | 12.26 |
| 2013 | 388 | 5.23 | -0.22 | 4666 | 12.02 |
| 2014 | 389 | 5.24 | 0.001 | 4582 | 11.77 |
| 2015 | 462 | 6.23 | 0.15 | 5593 | 12.10 |
| 2016 | 524 | 7.06 | 0.11 | 5522 | 10.53 |
| 2017 | 452 | 6.09 | -0.15 | 5334 | 11.80 |
| 2018 | 608 | 8.19 | 0.25 | 5556 | 9.13 |
| 2019 | 664 | 8.95 | 0.08 | 5437 | 8.18 |
| 2020 | 507 | 6.83 | -0.31 | 4225 | 8.33 |
| 2021 | 607 | 8.18 | 0.16 | 3500 | 5.76 |
| 2022 | 598 | 8.06 | -0.01 | 2328 | 3.89 |
| 2023 | 634 | 8.55 | 0.05 | 1073 | 1.69 |
| Total | 7415 | 100 | | 65563 | |

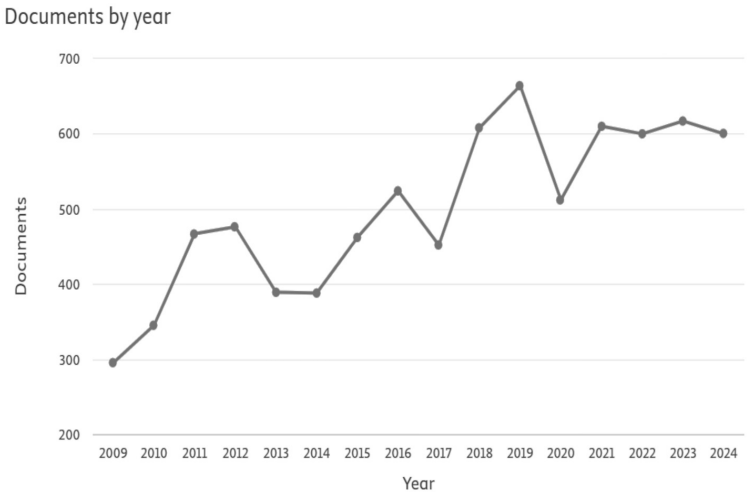


**Figure 1: Research publication growth of AU**

Table 1 and Figure 1 show that the number of publications fluctuated over the years, with a noticeable

increase from 294 in 2009 to a peak of 664 in 2019, followed by a decline in subsequent years. The annual growth rate varies annually, with both positive and negative trends observed. The most significant positive growth was in 2018 (0.25), while the most substantial decline occurred in 2020 (-0.31). The total number of citations received by publications fluctuated over the years, reaching its peak in 2015 with 5593 citations. However, there was a significant decrease in citations in the following years. The average number of citations per paper also varied annually, with higher values in the earlier years and a decline in recent years. The highest CPP was observed in 2009 (12.76), while the lowest was in 2023 (1.69)

### 5.2 Types of research publications

Table 2 and Figure 2 show that articles constitute the majority of publications, accounting for 77.16% of the total. Conference Papers represent 15.68% of the publications, followed by Book Chapters at 3.60%. Reviews, Errata, Retracted publications, Letters, Notes, Data Papers, Editorials, and Books make up smaller percentages of the total.

**Table 2. Types of research publications**

| Document Type | Publications | % | Citations | Average Citation per Paper (ACPP) |
|---|---|---|---|---|
| Article | 5722 | 77.16 | 55737 | 9.74 |
| Conference Paper | 1163 | 15.68 | 5369 | 4.61 |
| Review | 149 | 2.00 | 3559 | 23.88 |

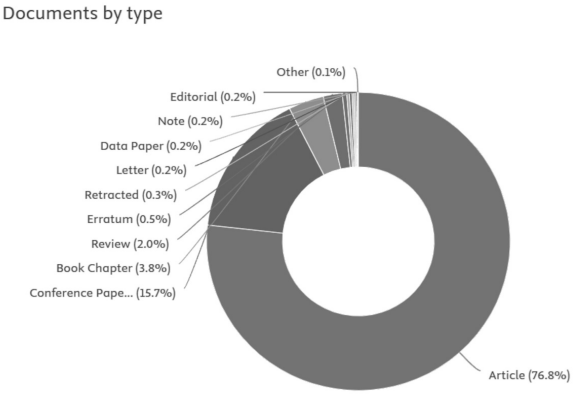


**Figure 2: Types of research publications**

Despite being the most common document type, articles have a moderate ACPP of 9.74, suggesting a reasonable impact. Reviews, though representing a small percentage of publications, have a notably higher ACPP of 23.88, indicating their significant influence in the academic community. Conference Papers have a relatively lower ACPP of 4.61, suggesting a lower average impact than Articles and Reviews. Books, while accounting for a small percentage of publications, have a relatively high ACPP of 18.5, indicating their substantial impact per paper.

### 5.3 TOP prominent authors

Table 3 shows that Authors such as Kora Pattabhi Rama Chowdary from Pharmaceutical Sciences, V. Veeraiah from the Department of Physics, and K. Samatha from the Department of Physics have notably high publication counts, with 82, 80, and 77 publications, respectively.

**Table: 3 TOP prominent authors**

| Author | Department | Publication | Citations | H-Index | ACPP |
|---|---|---|---|---|---|
| Chowdary, Kora Pattabhi Rama | Pharmaceutical Sciences | 82 | 171 | 7 | 2.08 |
| Veeraiah, V. | Department of Physics | 80 | 1004 | 18 | 12.55 |
| Samatha, K. | Department of Physics | 77 | 726 | 16 | 9.42 |
| Murthy, Y.L.N. | Organic Chemistry | 77 | 1122 | 17 | 14.57 |
| Murali, N. | Department of Physics | 77 | 1017 | 18 | 13.20 |
| Vaisakh, K. | Department of Electrical Engineering | 73 | 945 | 13 | 12.94 |
| Rao, V.U.M. | Dept. of Applied Mathematics | 71 | 904 | 20 | 12.73 |
| Ramji, K. | Department of Mechanical Engineering | 67 | 924 | 16 | 13.79 |
| Rao, G.N. | Department of Chemistry | 64 | 237 | 8 | 3.70 |
| Rajesh Kumar, P. | Dept. of Electronics and Communication Engineering | 63 | 454 | 9 | 7.20 |
| Basavaiah, K. | Department of Analytical Chemistry | 62 | 970 | 17 | 15.64 |
| Shyamala, P. | Department of physical, nuclear chemistry, and chemical oceanography | 61 | 192 | 7 | 3.14 |
| Rao, G.S. | Department of Electronics and Communication Engineering | 58 | 178 | 8 | 3.06 |
| Vangalapati, M. | Dept of ChemicalEngineering | 56 | 516 | 10 | 9.21 |

Authors like Y.L.N. Murthy from Organic Chemistry, N. Murali from the Department of Physics, and Vaisakh K. from the Department of Electrical Engineering have achieved substantial citation counts, with 1122, 1017, and 945 citations, respectively. Several authors, including V.U.M. Rao from the Department of Applied Mathematics, Veeraiah from the Department of Physics, and Murthy from Organic Chemistry, have achieved impressive H-Index scores of 20, 18, and 17, respectively, indicating the impact and productivity of their scholarly work. Authors like Basavaiah from the Department of Physics, Murthy from Organic Chemistry, and Ramji from the Department of Mechanical Engineering have notably high ACPP values, indicating that their publications receive a high average number of citations per paper.

### 5.4 Top 10 ranked publications

Table 4 shows that several journals from India are represented in the table, including "The Asian Journal of Chemistry," "The Research Journal of Pharmaceutical Biological and Chemical Sciences," "The Journal of the Indian Chemical Society," and others.

**Table: 4 Top 10 ranked publications**

| Name of the Journal | Publications | H-Index | Citations | Country | Citescore-2022 |
|---|---|---|---|---|---|
| Asian Journal of Chemistry | 179 | 10 | 404 | India | 0.9 |
| Research Journal of Pharmaceutical Biological and Chemical Sciences | 69 | 8 | 266 | India | Not available |
| Journal Of the Indian Chemical Society | 67 | 9 | 189 | India | 1.3 |
| Rasayan Journal of Chemistry | 54 | 11 | 466 | India | Not available |
| International Journal of Pharmacy and Pharmaceutical Sciences | 54 | 9 | 310 | India | Not available |
| Research Journal of Pharmacy and Technology | 53 | 5 | 88 | India | 1.3 |
| Der Pharma Chemica | 50 | 7 | 152 | India | Not available |
| International Journal of Applied Engineering Research | 47 | 7 | 156 | India | Not available |
| International Journal of Innovative Technology and Exploring Engineering | 45 | 4 | 54 | India | Not available |
| Astrophysics and Space Science | 43 | 16 | 609 | Netherlands | 3.4 |

The highest publication count is observed for the "Asian Journal of Chemistry" with 179 publications, followed by the "Research Journal of Pharmaceutical Biological and Chemical Sciences" with 69 publications. The CiteScore, which measures the average citations received per document in a particular year, varies across journals. For instance, the "Astrophysics and Space Science" journal from the Netherlands has the highest CiteScore of 3.4, indicating a relatively higher citation impact than other journals in the list. The "Astrophysics and Space Science" journal also stands out with the highest H-Index of 16 and the highest citation count of 609, suggesting significant influence and impact in its field. Other journals like "The Rasayan Journal of Chemistry" and "The International Journal of Pharmacy and Pharmaceutical Sciences" also demonstrate notable H-Index and citation counts, reflecting their contribution to scholarly literature. Most journals listed are based in India, indicating a strong presence of Indian research publications in the analysed dataset. However, one journal, "Astrophysics and Space Science," is based in the Netherlands.

### 5.5 Country-wise distribution of publications

Table 5 shows that theUSA has the highest number of publications, with 145, comprising 1.95% of the total publications analysed. Other countries with notable publication counts include Ethiopia (121), South Korea (96), and Saudi Arabia (65).

**Table 5: Country-wise distribution of publications**

| Country | Publications | % | Citations | % | Average Article Citations |
|---|---|---|---|---|---|
| USA | 145 | 1.95 | 3331 | 5.08 | 22.97 |
| Ethiopia | 121 | 1.63 | 1613 | 2.46 | 13.33 |
| South Korea | 96 | 1.29 | 2555 | 3.89 | 26.61 |
| Saudi Arabia | 65 | 0.87 | 962 | 1.46 | 14.8 |
| Malaysia | 53 | 0.71 | 2139 | 3.26 | 40.35 |
| Italy | 48 | 0.64 | 1271 | 1.93 | 26.47 |
| China | 45 | 0.60 | 1600 | 2.44 | 35.55 |
| UK | 44 | 0.59 | 1477 | 2.25 | 33.56 |
| Brazil | 42 | 0.56 | 719 | 1.09 | 17.11 |
| Japan | 41 | 0.55 | 1567 | 2.39 | 38.21 |
| Nepal | 37 | 0.49 | 619 | 0.94 | 16.72 |
| Australia | 34 | 0.45 | 1175 | 1.79 | 34.55 |
| Germany | 33 | 0.44 | 727 | 1.10 | 22.03 |
| Chile | 31 | 0.41 | 977 | 1.49 | 31.51 |
| South Africa | 29 | 0.39 | 809 | 1.23 | 27.89 |

Malaysia has the highest citation count with 2139 citations, followed closely by South Korea (2555) and China (1600). Despite having the highest publication count, the USA ranks fourth in terms of citation count with 3331 citations. Malaysia stands out with the highest average article citations at 40.35, indicating a high impact of its publications relative to the publication count. Other countries with notable average article citations include Japan (38.21), China (35.55), and Australia (34.55). The analysis comprises countries from various regions, demonstrating the global nature of research contributions. Asian countries such as South Korea, China, and Malaysia have shown firm publication count and citation impact performance. European countries like Italy, the United Kingdom, and Germany contribute significantly to the research output, although with relatively lower publication counts than Asian countries.

### 5.6 Highly cited publications from the AU

Table 6 highlights ten highly cited papers demonstrating the impact of Andhra University's research.

**Table: 6 Highly cited publications from the AU**

| S No | Title | Citations |
|---|---|---|
| 1 | Comparative antioxidant and anti-inflammatory effects of [6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol | 540 |
| 2 | Green synthesis and characterization of silver nanoparticles using Boerhaavia diffuse plant extract and their anti-bacterial activity | 343 |
| 3 | Cross-linked hydrogel for pharmaceutical applications: A review | 318 |
| 4 | Effect of fiber surface treatments on mechanical and abrasive wear performance of polylactide/jute composites | 306 |
| 5 | Review on nanomaterials: Synthesis and applications | 305 |
| 6 | Global, regional, and national burden of diabetes from 1990 to 2021, | |

| | | |
|---|---|---|
| | with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021 | 291 |
| 7 | Investigations on mechanical properties of aluminum hybrid composites | 284 |
| 8 | A novel approach to identify optimal access point and capacity of multiple DGs in a small, medium and largescale radial distribution systems | 279 |
| 9 | A comprehensive review on polyelectrolyte complexes | 278 |
| 10 | Green Synthesis of Copper Oxide Nanoparticles Using Aloe vera Leaf Extract and Its Antibacterial Activity Against Fish Bacterial Pathogens | 275 |

These papers were published in prestigious journals and reflect the university's collaboration with international and domestic institutions.

### 5.7 Top 10 Collaborations of AU

Table 7 presents an overview of the publication output from various institutions. The Andhra University College of Engineering has the highest number of publications in 1714, accounting for 23.11%.

**Table: 7 Top 10collaborations of AU**

| S No. | Name of the Institution | Publications | % |
|---|---|---|---|
| 1 | Andhra University College of Engineering | 1714 | 23.11 |
| 2 | GITAM University | 1000 | 13.48 |
| 3 | Andhra University College of Pharmaceutical Sciences | 749 | 10.10 |
| 4 | Jawaharlal Nehru Technological University, Kakinada | 231 | 3.11 |
| 5 | Anil Neerukonda Institute of Technology and Sciences | 230 | 3.10 |
| 6 | K L Deemed to be University | 175 | 2.36 |
| 7 | GMR Institute of Technology | 161 | 2.17 |
| 8 | Gayatri Vidya Parishad College of Engineering | 137 | 1.84 |
| 9 | Vignan Institute of Information Technology | 131 | 1.76 |
| 10 | S.R.K.R.Engineering College | 130 | 1.75 |

Other notable contributors include GITAM University, with 1000 publications (13.48%), and the Andhra University College of Pharmaceutical Sciences, with 749 publications (10.10%). Jawaharlal Nehru Technological University, Kakinada, Anil Neerukonda Institute of Technology & Sciences, and K L Deemed to be University also made significant contributions, with over 200 publications. This distribution highlights the region's diverse research activities across multiple academic institutions, with Andhra University being the most prolific contributor.

### 5.8 Documents by Subject Area

Table 8 shows the distribution of documents by subject-wise during the present study period.

**Table 8: Distribution of Documents by Subject wise**

| S. No. | Type of Document | No. of Documents |
|---|---|---|
| 1 | Engineering | 2400 |
| 2 | Computer Science | 1369 |
| 3 | Chemistry | 1305 |
| 4 | Pharmacology, Toxicology and Pharmaceutics | 1161 |
| 5 | Materials Science | 1092 |

It is indicated that Engineering documents are the most cited documents with 2400 numbers and followed by Computer Science, Chemistry and so on.

### 5.9 Keyword distribution of Andhra University

Figure 4 illustrates the primary subject keywords associated with Andhra University's research output from 2009 to 2023.

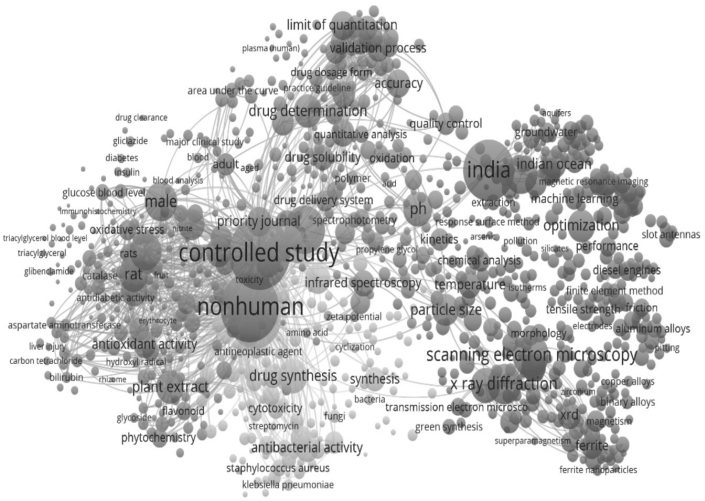


**Figure4: Keyword distribution of Andhra University**

Among 95809 keywords analysed, "Controlled Study" emerged as the most prevalent, constituting 677 of the total Occurrences, securing the top position. Following closely, "Nonhuman" claimed the second spot with 637 occurrences, accounting for 1.44% of the total keywords. The term "Unclassified drug" attained the third rank with 537 instances, representing 1.35% of the total keywords. Occupying the fourth position, "Unclassified drug" was identified in 522 keywords, constituting 1.16% of the total. Conversely, the term "Plant extract" appeared least frequently among the top ten keywords, with only 181 instances, comprising 0.40% of the total analyzed keywords.

### 5.9.1 Co-authorship network of Andhra University authors

Figure 5 depicts the collaborative relationships observed within Andhra University's research publications from 2009 to 202

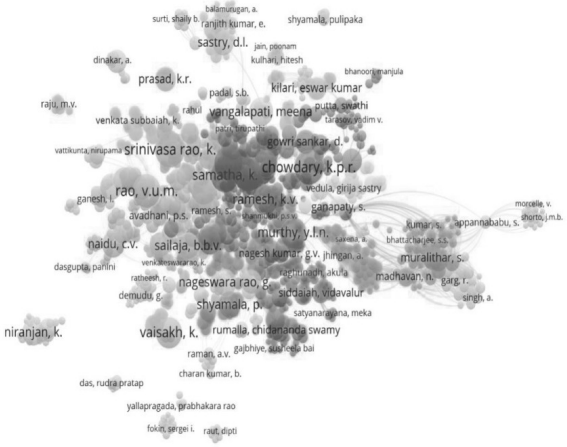


**Figure5: Co-authorship network of Andhra University authors**

Focusing on documents jointly authored by at least three contributors and cited at least once. The visualisation presents a total of 960 individual items interconnected by 5246 links. Notably, Muralithar, S., affiliated with the Inter-University Accelerator Centre India in New Delhi, India, emerges as a central figure in the network with 79 links. Following closely is Singh, R.P., associated with GLA University in Mathura, India, with 73 links, indicating their significant contributions to collaborative research endeavours within Andhra University's scholarly landscape.

## 6. Major findings

Here are the main findings from the study:

- The University's publication output exhibited fluctuations over the studied period, notably rising from 294 in 2009 to a peak of 664 in 2019 before experiencing a subsequent decline.
- A significant majority (77.16%) of the University's research contributions were disseminated through journal articles, highlighting the preference for this form of scholarly communication.
- The Asian Journal of Chemistry emerged as the most favoured publication venue, hosting 179 articles from the University. This preference underscores the inclination of authors toward journals with commendable citation scores, reflecting the University's commitment to disseminating research in reputable outlets.
- Among the prolific authors, Chowdary, Kora Pattabhi Rama stood out with an impressive record of 82 published articles, complemented by an outstanding h-index of 7. Additionally, notable international collaboration efforts were observed, with 864 contributions from the top 10 international countries reflecting the University's engagement on a global scale.
- The University's collaborative efforts extended globally, with the United States of America being a prominent partner. This collaboration positioned the University as the second most engaged institution internationally, following India, regarding research publications.

## 7. Conclusion

This analysis of Andhra University's research publications indexed in SCOPUS from 2009 to

2023 reveals notable growth in both the quantity and quality of its scholarly output. The significant contributions from the science and engineering departments underscore the university's academic strength. The findings highlight the university's preference for publishing in reputable journals and active engagement in international collaborations. This study's insights are valuable for strategic planning and funding allocation to enhance research productivity at Andhra University.

Even though Andhra University's library offers many e-resources, there's still a need to make sure teachers and researchers know how to use them, especially for science and engineering subjects. The results of this study could help groups that plan strategies and give money to Andhra University. The study also found that the engineering, Computer science, and Chemistry departments are the most active at Andhra University. It's a good idea for funding groups to give these departments more money for research grants. This could lead to more research papers being published in the future.

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